

Role of kidney in long term regulation

The kidney is a very important organ; it is known that it excrete waste products from the body. It also has an important role in controlling pressure for long periods in a process called “Renal-Body fluid system”.

If blood volume increases and vascular capacitance is not altered, arterial pressure will also increase. The rising pressure in turn causes the kidneys to excrete the excess volume, thus returning the pressure back toward normal. Thus we see that renal output of water and salt is sensitive to the change in arterial pressure, whenever arterial pressure increases renal output of water and salt increase and vice versa.

Taking into consideration that the renal output is known as “pressure diuretic”, while renal output of salts is known as “pressure natriuretic”

The increase in salt intake increases arterial pressure more than water intake, why is that?

It happens because: - water is easily and rapidly excreted.

salt can lead indirectly to increase extracellular fluid volume for two reasons:

1. The increase in salt intake increases the osmolarity of the extracellular fluid will increase (normal extracellular fluid volume osmoarity is 300 osmole/L), and if that happened it will stimulate the thirst center in brain, thus, the person will drink more water, extracellular fluid volume increase.
2. When extracellular fluid volume increase, the secretion of ADH increase so more absorption of fluid occur, thus, increase in extracellular fluid volume.

In this way salt intake is more likely to increase arterial pressure than water intake do, that’s why

patients with hypertension must reduce salt intake

Rennin-angiotensin system :

Another mechanism related to kidney is known as “Rennin-angiotensin system”.

Rennin enzyme is synthesized and stored in its inactive form ‘prorennin’ in the juxtaglomurlar cells which are found in the wall of the afferent arterioles proximal to the glomeruli.

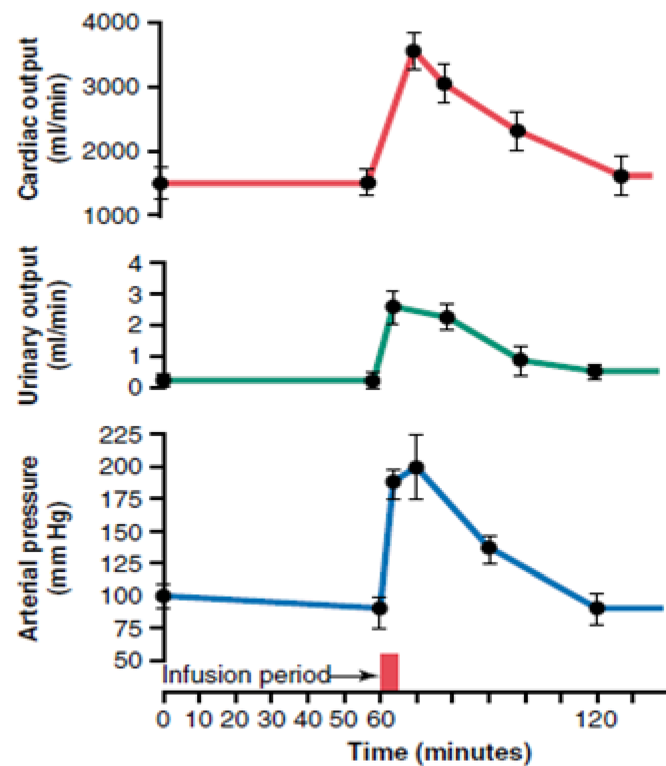
When arterial pressure decreases, blood flow to the kidney decreases too, so intra renal reaction will lead to the release of rennin enzyme to blood circulation. In blood circulation, rennin act on plasma protein called angiotensinogen (inactive) turning it to its active form angiotensin 1 (which is a mild vasoconstrictor). In small vessels of lung there is another enzyme called “angiotensin converting enzyme” (also found in another blood vessels but in lesser amount than in lungs). This enzyme converts angiotensin 1 to angiotensin 2.

Angiotensin 2 is a powerful vasoconstrictor that:

1. Acts mainly on arterioles increasing the resistance
2. Acts also on veins increasing blood pressure, which will increase venous return and cardiac output.
3. On kidney, it increases renal absorption of water and salt, which will increase extracellular fluid volume and blood volume.
4. On adrenal cortex, it stimulates the secretion of aldosterone hormone which increases renal reabsorption of salt and water, increase extracellular fluid volume, cardiac output and arterial pressure toward normal.

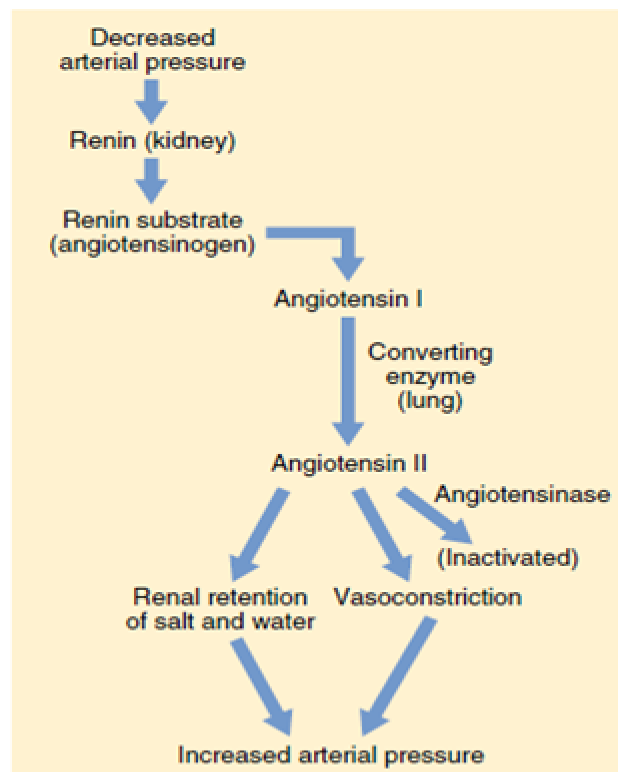
Normal person with normal rennin-angiotensin system can regulate –decrease or increase- pressure with the intake of salt and water. So how does this happen?
According to the mechanism mentioned above, increase in salt intake will lead to increase arterial pressure, increase blood flow to kidney and decrease the secretion of rennin toward normal.

In this figure:

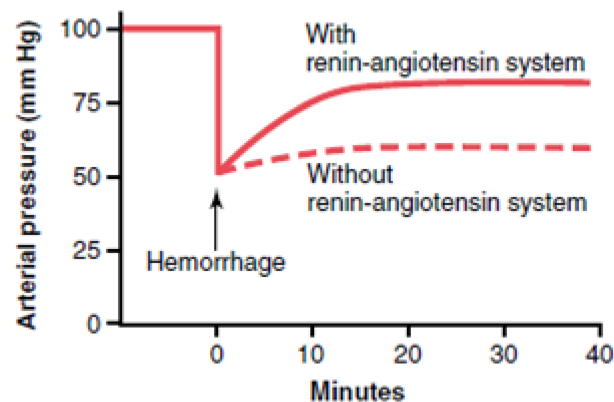


The increase in the extracellular fluid volume will lead to an increase in blood volume which in turn will lead to an increase in venous return, arterial pressure and urine output.

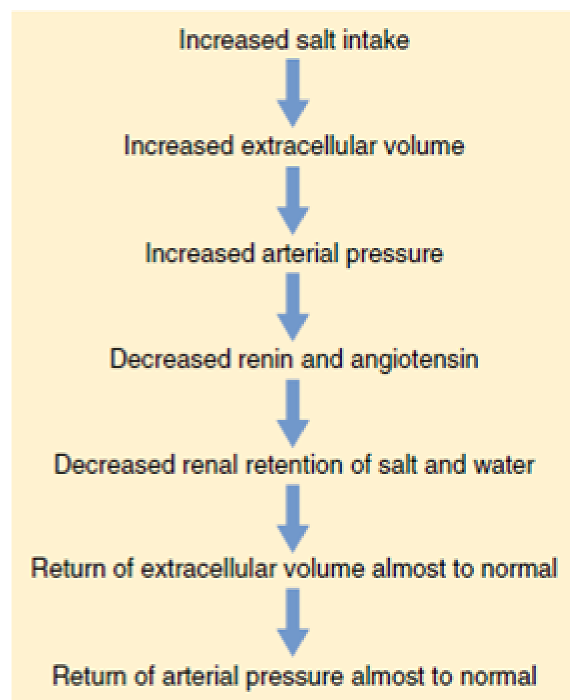
This figure explains the mechanism in which arterial pressure is regulated by Rennin angiotensin system:



If we have pressure of 100 and a hemorrhage occur the pressure will decrease to 50, so if the rennin angiotensin system acts normally it will change the situation toward normal, but if it is not it will fail to return pressure toward normal.



This one explains what happens when there is increase in salt intake:



هذا عمل طلابي قد لايخلو من الخطا فالرجاء ابلاغنا ف حالة وجود خطا ولاتنوسونا من صالح الدعاء


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